NASA SBIR/STTR Technologies

S1.06-9362 - Lightweight Superconducting Magnets for Low Temperature Magnetic Coolers

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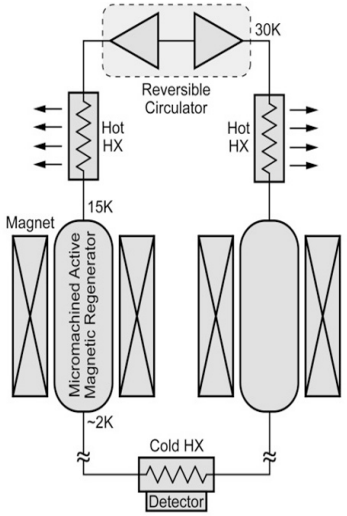
Identification and Significance of Innovation

A lightweight, reliable, efficient Active Magnetic Regenerative Refrigeration (AMRR) system for space applications
- Cooling temperatures in the range of 2 K
- Heat sink temperatures higher than 15 K
- Ability to provide remote/distributed cooling

Propose to develop an innovative high temperature, lightweight superconducting magnet
- Enable efficient operation of the AMRR
- Increase AMRR heat sink temperature

Advanced superconducting magnet with low-current superconducting tapes and a unique coil arrangement to achieve
- High field (5 T)
- High operating temperature (> 15 K)
- A time-varying spatial distribution for optimum AMRR performance

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



System Schematic of an AMRR

- Technologies for the reversible cryogenic circulator have been developed
- Regenerator technologies are being developed. Key milestones have been achieved.
- Here we propose to develop technologies for the lightweight superconducting magnets
- In Phase III we will build a complete AMRR

Technical Objectives and Work Plan

Technical Objectives:

- A lightweight magnet with low parasitic losses
- Compact magnetic shields and magnet support systems
- An optimum magnetic field design to minimize the overall mass of the AMRR

Work Plan:

Phase I

- Develop a winding configuration for the magnets to generate a magnetic field with a time-varying spatial distribution
- Develop a magnet performance analysis model
- Develop designs for the magnetic shield and magnet support systems
- Produce an optimal AMRR design and its predicted performance data

Phase II

- Fabricate and test a superconducting magnet
- Obtain performance data for the magnetic regenerator and SC magnet assembly

NASA Applications

- Cooling systems for cryogenic detectors for sensing X ray, infrared, and sub-millimeter radiation (bolometers and microcalorimeters)

- Lightweight, low-current, high temperature superconducting magnets for science instruments

Non-NASA Applications

Cooling systems for:

- Superconducting digital electronics
- Superconducting RF cavity for accelerators
- MRIs

Firm Contacts

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